natural size, was obtained by Sir George Baden Powell in Petropaulovski harbour, Kamtschatka, on Sept. 8, 1891. Before describing this fish as new I have satisfied myself, by a careful comparison with the original description, that it cannot by any means be referred to *Ophidium ocellatum*, Tilesius, which it strongly resembles in general appearance. Notwithstanding the several different names which have been bestowed upon it, this *Ophidium ocellatum*, obtained at Petropaulovski, has not been rediscovered since its description in 1811, and its affinities are altogether uncertain.

3. On some cases of Variation in Secondary Sexual Characters, statistically examined. By W. Bateson, M.A., Fellow of St. John's College, Cambridge, and H. H. Brindley, M.A., St. John's College, Cambridge.

[Received November 15, 1892.]

It is a familiar fact that many insects are provided with long, chitinous horn-like processes of various shapes and forms. Such horns are sometimes present in both sexes, but more commonly they attain their chief development in the male only. Among beetles the most striking examples are found in the Lamellicorns, many of which have horns of great size on the head, or on the thorax, or on both. Analogous developments are seen in the great mandibles of the males in some Lucanidæ, of which the Stag-beetle (*Lucanus cervus*) is a common representative. In the majority of these forms the similar parts of the females are either not produced at all or are much smaller. Now in many species having these curious horns in the male sex, it has long been observed that the males are not all alike in the degree to which the horns are developed; but that, on the contrary, some of the males may bear massive horns of prodigious size, while other males of the same species have hardly any horns at all, being in fact very like females. The males with the great horns are in common parlance known as "high" males, those with the rudimentary horns being "low" males. A good series of figures illustrating the phenomenon is given by Darwin[1], and examples of such Variation in *Odontolabis* &c. are exhibited in a show-case in the Natural History Museum at South Kensington.

The phenomenon of great Variation in the development of horns present in the males as a secondary sexual character is not peculiar to beetles, though in them it perhaps reaches a climax. A similar case is presented for instance by the Common Earwig (*Forficula auricularia*), in which the terminal forceps are in some males no larger than those of the female, while in others they are three times the size.

[1] 'Descent of Man,' 1871, vol. i. pp. 368–375.

The investigation we proposed to ourselves was as follows. Taking a species in which the horns of the male are sometimes small and sometimes of great size, we wished to see if individuals having any one degree of development of horns are more frequent than those having other degrees of development. The high males are an extreme form, and the low males are again an extreme form: would it then be found, on inquiry, that the mean form between these two is the commonest?

To those who are acquainted with the statistics set forth by Galton in 'Natural Inheritance' and elsewhere, it will be well known that measurements of certain quantities, as, for example, those of the stature of Englishmen, group themselves around a mean form in such a way that the curve representing the frequency of occurrence of the several measurements has the form known as a curve of Frequency of Error. In other words, there is a mean stature for that group of persons, and variations from this mean are rarer in proportion as they depart from it. Persons of mean stature are common, while the tall and the short are rarer. This group of individuals may then be described as *monomorphic* in respect of stature. If, on the other hand, it were found that tall persons were common and short persons were common, but persons of middle height were rare, such a group might be called *dimorphic* in respect of stature, and the curve representing the frequency of their various statures would not form one Curve of Error with one peak, but would have *two* peaks. In two of the three examples about to be described, the statistics showed that such dimorphism does actually exist, and that it is not the mean form which is the commonest, but rather the moderately high and the moderately low. After these remarks we may now describe our observations.

I. Forficula auricularia. (*The Common Earwig.*)

In a visit to the Farne Islands off the coast of Northumberland it was noticed by one of us that these small rocks were inhabited by vast quantities of Earwigs. The Farnes are a group of basaltic islands about 3–5 miles out to sea, few of them having human habitations. They are a well known breeding-place for sea-birds of many kinds. Above high-water mark most of the rocks are covered with a deep, black vegetable mould in which *Silene maritima* grows luxuriantly, constituting the chief vegetation, and it is in this that the burrows of the Puffins are for the most part made.

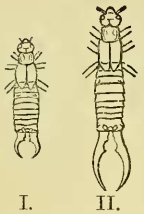
The abundance of Earwigs was most extraordinary. Under every stone or tussock there was an almost continuous sheet of Earwigs. This was the case not only among the sea-birds' nests, but also round the light-keepers' houses where no birds build. It did not seem, therefore, that the excessive quantity of Earwigs was necessarily connected with the presence of the nests.

It was at once seen that amongst these Earwigs were many males with extremely long forceps, like that shown in fig. 1, II. The usual form is seen in fig. 1, I, both figures being natural size. We

shall refer to these two forms as "high" and "low" males respectively.

It appears that the high male is known from many places in

Fig. 1.



Forficula auricularia, the Common Earwig.
I. Low male. II. High male.

England and elsewhere, and that it was made into a distinct species by Stephens[1] under the name *F. forcipata*. This species has not been retained by later authorities (see Fischer[2] and Brunner von Wattenwyl[3]). After the visit to the Farnes, the high males were found on the mainland near Bamborough in fair quantity, though not so abundant as on the Farnes. We have received also a large sample of Earwigs collected in a Cambridge garden, containing 163 males, of which 5 would come into the "high" class. A sample kindly collected for us by Dr. Norman, F.R.S., in his garden at Burnmoor, near Durham, contains no high male. The great abundance of high males at the Farnes seems to be quite exceptional.

With a view to determining the frequency of the high and low forms, 1000 of these Earwigs were collected for us by Miss A. Bateson on Sept. 12, 1892. The whole were taken in one day from three very small islands known as the Knocksies and Widerpern, which are joined to each other at low tide.

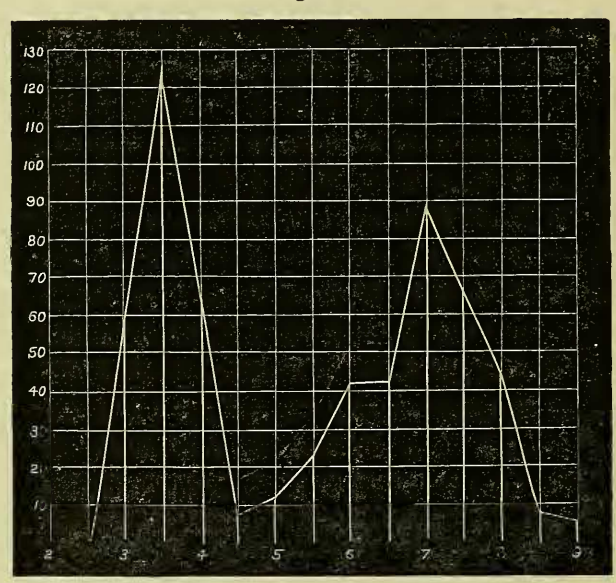
Of the 1000 specimens 583 proved to be mature males. Before giving the results of the measurements, it is perhaps necessary to give the reasons upon which we believe these specimens to have been all adult. In this matter we rely partly on the judgment of Dr. Sharp, F.R.S., who has most kindly assisted us in many ways throughout this investigation, and was so good as to take part in the work of measurement. We are informed by Dr. Sharp that the full development of the elytra is only reached in the adult state in *F. auricularia*, and we have been careful to include no specimen having imperfect elytra. As may be seen in the figures, the development of the elytra in the high and low males is the same. Besides

[1] 'British Entomology,' 1835, vi. p. 6, pl. xxviii. fig. 4.
[2] 'Orthoptera Europæa,' 1853, p. 74.
[3] 'Prodr. d. europ. Orthop.,' 1882, p. 12.

this, it is to be remembered that in most localities the high male is either unknown or very scarce, and it cannot be doubted that in these places the low males are really mature. Lastly, we know by the analogous case of horned beetles that high males coexist with low males, both being in this case of course mature. We think, therefore, that we are justified in considering that the 583 males available for measurement were all adult.

These specimens were laid out on squared millimetre paper covered with gum, and while the gum was still wet the posterior end of the forceps was brought up to one of the lines, and the length of the forceps was read to the nearest half millimetre, which is well within the limit of error. The results are set out in the accompanying curve (fig. 2), in which the figures on the ordinates denote

Fig. 2.



Curve showing frequency of occurrence of forceps of various lengths in male Earwigs (*F. auricularia*).

Ordinates give numbers of individuals; abscissæ give length of forceps in mm.

numbers of individuals, those on the abscissæ denoting millimetres. The smallest length of forceps was 2·5 mm., and the greatest 9 mm. As the curve shows, the greatest frequency is grouped about 3·5 mm. and 7 mm. respectively. The mean form, having forceps of moderate length, 4–6 mm., is comparatively rare. We consider that the number of cases is enough to justify the acceptance of these statistics, and it is unlikely that a greater number of cases would

much alter the shape of the curve[1]. The size of the forceps in the females scarcely varies at all, probably less than 1 mm. in the whole sample.

It is perhaps unnecessary to say that this result is of considerable importance to an appreciation of the way in which Variation may occur. There is here a group of individuals living in close communion with each other, high and low, under the same stones. No external circumstance can be seen to divide them, and yet they are found to consist of two well marked groups, containing about equal numbers. To those who are acquainted with the chapter on Organic Stability in Galton's 'Natural Inheritance,' this will be recognized as an instance of Variation about two positions of stability, the intermediate position being one of less stability. In the common language of naturalists, the facts of this case suggest that there is, for some wholly unknown reason, a dimorphism among the males of these Earwigs, maintained though all live together. In cases of dimorphism some have thought fit to speculate on the possible utility of the phenomenon. We know no basis of fact from which these discussions may be properly attempted, and we leave these matters to those who are satisfied with such methods of biological inquiry and have leisure and ingenuity to pursue them.

For the present we are content to recognize that in this case of the Earwig there is evidence of a definite and partially discontinuous Variation, in respect of a secondary sexual character.

II. Xylotrupes gideon.

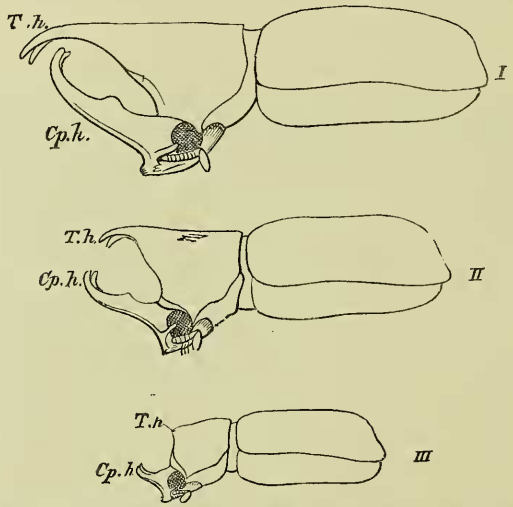
We are indebted to Baron A. von Hügel for a large supply of this species. They were collected by him at a height of 4000–5000 feet in the Willis Mountains, Kediri, Java, in February to April, 1878. In fig. 3 (p. 590) the males of this species are represented. As there seen, in this sex two horns are present, the one produced from the head, the other from the thorax. The two horns lie in the same vertical plane, and each ends in a small fork. Taken together, these two horns thus constitute a pair of forceps, which can be opened by depressing the head. The points of the forceps do not exactly meet, but the point of the cephalic horn in high males is overlapped by that of the thoracic horn. As the figures show, there is very great variation in the degree to which these horns are developed in the male, the three drawings representing "high," "medium," and "low" males respectively. In the female neither horn is developed, but there is considerable variation in total length. As may also be seen in the figures, those males which have very large horns are

[1] In most insects having high and low males, the high males are large in every way, while the low males are small. That this is so, generally speaking, in these Earwigs was clear, but it is not possible to get reliable measurements of total length, owing to the fact that the abdominal segments "telescope" into each other. Hence no examination of the correlation between total length and the length of the forceps could be attempted. There is nevertheless no doubt that the ratio of the length of the forceps to the total length is higher in high males than in the low.

also in other ways large individuals, while the males with small horns are small individuals. But though there is some correlation between absolute size and the degree to which the horns are developed, our measurements have shown that this correlation is not perfect. It is of course clear that the ratio of length of the horns to that of the body is greater in the high males than in the low.

Baron von Hügel gave us some interesting particulars as to the natural history of these beetles. They were collected in the height of the breeding-season, perhaps the greater number being found coupled. It was noticed that large males were often attached to

Fig. 3.



Diagrams of *Xylotrupes gideon*, ♂, seen from side. Legs not shown.
I. High male. II. Medium male. III. Low male.
T.h., thoracic horn; *Cp.h.*, cephalic horn.

small females and the reverse, but there appeared to be no regularity in this. In view of the circumstance that there are scarcely any observations as to the functions of the horns of beetles, the following statements of Baron von Hügel are especially noteworthy. He says that the animals were caught by himself and by natives, and were tied up with pieces of bast. When they were brought home and untied, the males immediately sought out the females, and seizing them transversely, carried them about, held between the two horns, with evident satisfaction. He tells us that this was observed again and again, and was clearly a definite habit. The males with small horns, though unable to lift the females, nevertheless made ludicrous efforts to do so. In answer to the question whether it was observed that these small males did not succeed in obtaining females

in the state of nature, Baron von Hügel tells us that he has no reliable recollection on this point.

The habit described above is not confined to *X. gideon*, for Baron von Hügel observed it also on one occasion in the case of *Chalcosoma atlas*, the well-known Atlas-beetle. A pair of this species from Java were presented by him to the Cambridge Museum, which were thus found, the female being carried between the horns of the male. In view, therefore, of the fact that the horns of many species are in various ways disposed as a pair of forceps, it is possible that this may be a habit widely spread; but that such a function cannot be attributed to all the cases of horns is shown by the fact that in many species the horns do not form a pair of forceps.

In 342 males of this beetle the cephalic horn was measured with compasses from the angle of the terminal fork to the edge of the ridge into which the horn is proximally and ventrally reflected, just in front of the eyes. The results obtained are tabulated in fig. 4, according

Fig. 4.

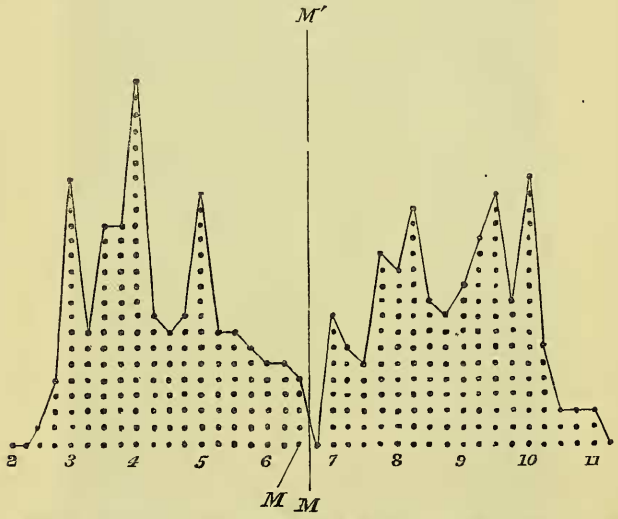


Diagram showing frequency of various lengths of the cephalic horns in *Xylotrupes gideon*, ♂.

M, mean case; M′, mean value. Ordinates show number of cases; abscissæ show lengths four times nat. size. The numbers give the lengths in lines.

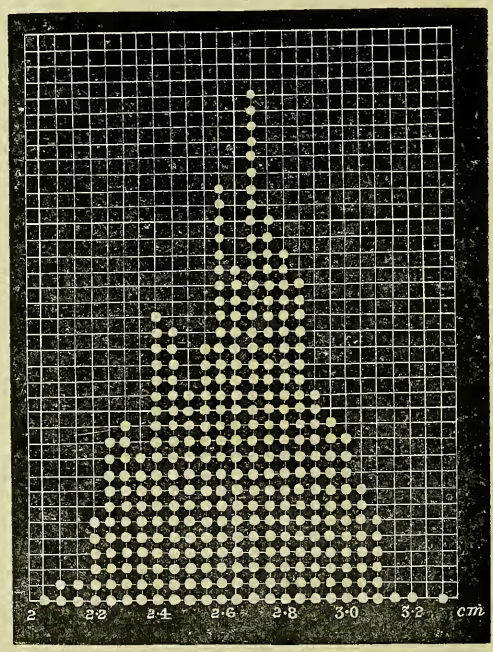
to the common system. Each dot represents a case, and the ordinates thus give the numbers of cases, while the abscissæ show the lengths of the horns; for clearness these measurements are shown four times the natural size. The shortest cephalic horn was 0·4 cm., while the longest was 2·4 cm. As the diagram shows, in the neighbourhood of the mean value (M′) for the length of horn the

specimens were few, while the moderately high and moderately low males are common, the two groups being about equally numerous.

Measurements of the thoracic horn showed a similar dimorphism; but, for the reason that it is not possible to measure this horn apart from the thorax, these measurements are not so satisfactory.

The length of the elytra was also measured, and it may perhaps be taken as a measure of the body-length. For various reasons it is hard to obtain any more satisfactory measurement of the body-length. Such a measurement must either include the variable horns or else must depend on the degree of flexion of head or thorax. The result of the measurement of the elytra is perhaps unexpected in view of the knowledge that there is dimorphism in respect of the cephalic horn. Fig. 5 shows the result of grouping the statistics as to the

Fig. 5.



Xylotrupes gideon, ♂. Table of frequency of elytra of various lengths. Ordinates show number of cases; abscissæ show lengths of elytra in cm.

frequency of the various lengths of elytra, and it is hence clear that the mean form is the commonest, just as it is in the case of the stature of a given human community. Though dimorphic in respect of the length of the horns, these males are thus monomorphic as regards the elytra. There is of course nothing really contrary to

expectation in the fact that a race is dimorphic in respect of one character while in respect of another it is monomorphic.

III. Lucanus cervus. (*The Stag-beetle.*)

Of this insect we have no quantity of males sufficient to justify a statement that in respect of the development of the mandibles it is monomorphic or dimorphic. It is well known that very striking differences are found between high and low males in this species.

Males to the number of 115 obtained at Woking in 1891 and 1892 have been measured. The lengths of the mandibles from the apex to the internal angle between the base and the head were taken with compasses, and the result is exhibited in fig. 6. The fact that this

Fig. 6.

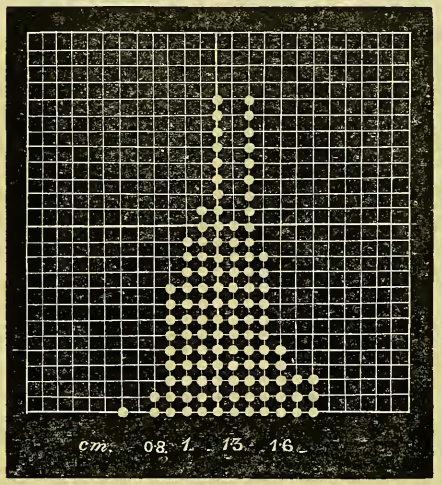


Table of frequency of various lengths of mandible in *Lucanus cervus*, ♂.
Ordinates show number of cases; abscissæ give lengths of mandibles in cm.

sample is monomorphic is quite clear, for the numbers are plainly grouped round the middlemost value. But in this case there is serious reason to doubt whether the sample examined contains really low males. In our experience of the Earwig's forceps and the *Xylotrupes* horns, the low males are almost like the females; but in the case of the Stag-beetle the mandible of the lowest male seen was much greater than that of the females. It seems possible that in the Stag-beetle the truly low male is either very rare or does not occur, and that the existing individuals belong to a group answering to those which were found in *Xylotrupes* above the middlemost value. There is in fact a possibility that we have in the Stag-beetle a case which is the converse of that of the Earwig. In most places the low male Earwig is to be found, the high male being absent or

very scarce, but in the Stag-beetle it is the high male that is common while in most places the low male is absent or scarce.

In this case, and in that of *X. gideon* also, the ratio of the mandibles or horns to the total length is higher in the high males than in the low males; or, in other words, though the body of a high male is larger than that of a low male, the horns of the high male are still larger in proportion to the body than those of the low male.

In conclusion we would call attention to the fact that fantastic secondary sexual horns present one of the most difficult problems in Evolution, for as to their modes of origin even guesses can scarcely be made. To their production a considerable expenditure of energy is clearly needed, and yet in many cases they have no obvious function. They are, further, notoriously variable. Darwin on the whole was disposed to regard them as ornaments. The knowledge therefore that variation in the degree of development of these structures may be discontinuous is a material assistance to the formation of any conception as to the manner of their origin. The question may be asked, does the dimorphism of which cases have now been given represent the beginning of a division into two species, or rather a division which might be accentuated so as to lead to such division? To this question we have no answer to make, but such a possibility may well be remembered.

We must express our thanks to Messrs Macmillan for their kindness in allowing us to use the drawings of figs. 1–4, which have been prepared by them in illustration of a forthcoming book by one of us on the subject of Variation.

December 6, 1892.

Dr. St. George Mivart, F.R.S., Vice-President, in the Chair.

The Secretary read the following report on the additions to the Society's Menagerie during the month of November 1892:—

The total number of registered additions to the Society's Menagerie during the month of November were 144, of which 94 were by presentation, 7 by birth, 39 by purchase, 2 by exchange, and 2 on deposit. The total number of departures during the same period, by death and removals, was 82.

Dr. S. J. Hickson, F.Z.S., read a paper entitled "A Revision of the Genera of the *Alcyonaria Stolonifera*, with a Description of one new Genus and several new Species," of which the following is an abstract:—

In a communication made to the Royal Society in 1883, the author proposed to separate those Alcyonarians in which the polyps spring independently from a creeping stolon into a suborder, the Stolonifera.

The author's views have not been accepted by von Koch, Viguie,

Perceval Wright, and Studer, but a renewed investigation of the genera belonging to the suborder has convinced him that the proposed classification is perfectly justified. The suborder Stolonifera may be defined as follows:—

Colonial Alcyonaria with a membranous or ribbon-like stolon. Mesogloea poorly developed. Polyps either entirely free from one another except at their bases, or connected by horizontal platforms (*Tubipora*) or connecting tubes (*Clavularia viridis* and the fossil *Syringopora*). Skeleton composed of calcareous spicules which may be joined together to form firm tubes, or free from one another, or absent. In some cases the body-walls supported by a horny secretion.

The suborder Stolonifera contains two families: Tubiporidæ and Clavulariidæ.

The family Tubiporidæ contains one genus: *Tubipora*.

The family Clavulariidæ contains four genera: *Clavularia*, *Cornularia*, *Stereosoma*, and *Sympodium*, and probably *Syringopora*.

The genus *Cornularia* may be defined as follows:—

Clavulariidæ without spicules. Stolons with a simple cavity. Polyps retractile. The basal parts of the polyps and stolon protected by a horny secretion.

The genus *Clavularia* may be defined as follows:—

Clavulariidæ with a membranous or retiform creeping stolon into which the polyps cannot be completely retracted. Spicules usually present. No horny secretion of the ectoderm formed.

The genus *Sympodium* may be defined as follows:—

Clavulariidæ with a thick plate-like stolon into which the polyps may be completely retracted.

The genus *Stereosoma* may be defined as follows:—

Clavulariidæ forming small colonies, consisting of stiff non-retractile polyps situated at considerable intervals from one another on a thick plate-like stolon. Tentacles non-retractile. Pinnæ few and widely separated from one another. Spicules absent.

Rhizoxenia, *Sarcodictyon*, *Anthelia*, *Gymnosarca*, *Cyathopodium*, and *Cornulariella* can no longer be retained as separate genera, as it is impossible to separate them from the genus *Clavularia*. The species of these genera therefore become species of *Clavularia*.

The following new species of Stolonifera are described:—

Stereosoma celebense, from the shore reefs of Talisse Island, North Celebes.
Clavularia garciæ, from Diego Garcia, shallow water.
Clavularia reptans, 5–20 fathoms off Talisse Island, N. Celebes.
Clavularia celebensis, shallow water, Talisse Island, N. Celebes.

The following species previously named by the author in the Proc. Royal Society of Victoria are described in detail for the first time:—

Clavularia australiensis, varieties A & B.
Clavularia ramosa.
Clavularia flava.

An account of the anatomy of *Clavularia viridis* of Quoy and Gaimard is also given.

This paper will be printed entire in the Society's 'Transactions.'

The following papers were read :—

1. On the Convolutions of the Cerebral Hemispheres in certain Rodents. By Frank E. Beddard, M.A., F.R.S., Prosector to the Society.

[Received December 6, 1892.]

The Rodents are for the most part smooth-brained animals ; there are, however, several exceptions to the universal applicability of this statement, which have been to some extent dealt with by previous writers, including myself. The Rodent brain has not, however, been subjected to that careful study to which the Ungulate and Carnivorous brains have in the hands of Dr. Krueg and Prof. Mivart. The only paper dealing with the Rodent brain in general known to me is by Dareste (1) ; but this article does not include a full description of the convolutions in any type except in the Capybara, though incidental references are made to other types in the author's general survey of the characters of the cerebral hemispheres in the group. Having formed a collection of Rodents' brains during the last year or two from material that came to hand at the Society's Gardens, I think it will perhaps be worth while to again call the attention of anatomists and systematists to the structure of the cerebral convolutions in this group of Mammalia. I have examined specimens of the following species, the brains of which show, at any rate, traces of convolutions :—

Cœlogenys paca.
Dasyprocta azaræ.
Lagostomus trichodactylus.
Capromys pilorides.
Hydrochœrus capybara.
Hystrix cristata.
Sphingurus prehensilis.
—— *villosus.*
Castor canadensis.
Cavia porcellus.
Octodon cummingi.
Myopotamus coypu.
Lepus cuniculus.
Aulacodus swindernianus.
Dolichotis patachonica.

The last two I have lately described in papers dealing with the general anatomy of the Rodents in question (3, 4). Several of these animals have been studied by previous observers; I shall refer to them in the following descriptive part of the present paper.